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JC05 Rec'd PCT/PTO 04 APR 2002

FORM PTO-1390 (REV. 12-2001)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 1085-043-PWH	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	
				10/089839	
INTERNATIONAL APPLICATION NO. PCT/GB00/03816		INTERNATIONAL FILING DATE Oct 4, 2000		PRIORITY DATE CLAIMED Oct 8, 1999	
TITLE OF INVENTION External Rotor Brushless DC Motor					
APPLICANT(S) FOR DO/EO/US RIDDOCH, Henry					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<ol style="list-style-type: none"><li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li><li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li><li>3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</li><li>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</li><li>5. <input type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))<ol style="list-style-type: none"><li>a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</li><li>b. <input type="checkbox"/> has been communicated by the International Bureau.</li><li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li></ol></li><li>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).<ol style="list-style-type: none"><li>a. <input type="checkbox"/> is attached hereto.</li><li>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</li></ol></li><li>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))<ol style="list-style-type: none"><li>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</li><li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li><li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li><li>d. <input type="checkbox"/> have not been made and will not be made.</li></ol></li><li>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).</li><li>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li><li>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li></ol>					
Items 11 to 20 below concern document(s) or information included:					
<ol style="list-style-type: none"><li>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li><li>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li><li>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</li><li>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</li><li>15. <input type="checkbox"/> A substitute specification.</li><li>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</li><li>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</li><li>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</li><li>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</li><li>20. <input type="checkbox"/> Other items or information:     _US Express Mail No. EL817818793US     _Post card receipt     _International Preliminary Examination Report</li></ol>					

U.S. APPLICATION NO. <b>10/089839</b>	INTERNATIONAL APPLICATION NO. <b>PCT/GB00/03816</b>	ATTORNEY'S DOCKET NUMBER <b>1085-043-PWH</b>
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21. <input type="checkbox"/> The following fees are submitted: <b>BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. .... <b>\$1040.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... <b>\$890.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... <b>\$740.00</b>  International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... <b>\$710.00</b>  International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) ..... <b>\$100.00</b> <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>	<b>CALCULATIONS PTO USE ONLY</b>																					
	\$ 890.00																					
Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(c)).	\$																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%;">CLAIMS</th> <th style="width: 20%;">NUMBER FILED</th> <th style="width: 20%;">NUMBER EXTRA</th> <th style="width: 20%;">RATE</th> <th style="width: 20%;">\$</th> </tr> <tr> <td>Total claims</td> <td>18 - 20 =</td> <td>0</td> <td>x <b>\$18.00</b></td> <td>\$</td> </tr> <tr> <td>Independent claims</td> <td>2 - 3 =</td> <td>0</td> <td>x <b>\$84.00</b></td> <td>\$</td> </tr> <tr> <td colspan="4">MULTIPLE DEPENDENT CLAIM(S) (if applicable)</td> <td>+ <b>\$280.00</b></td> </tr> </table>	CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$	Total claims	18 - 20 =	0	x <b>\$18.00</b>	\$	Independent claims	2 - 3 =	0	x <b>\$84.00</b>	\$	MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ <b>\$280.00</b>	\$	
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Total claims	18 - 20 =	0	x <b>\$18.00</b>	\$																		
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<b>TOTAL OF ABOVE CALCULATIONS =</b>	\$ 890.00																					
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.	\$																					
<b>SUBTOTAL =</b>	\$ 890.00																					
Processing fee of <b>\$130.00</b> for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).	\$																					
<b>TOTAL NATIONAL FEE =</b>	\$ 890.00																					
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property +	\$ -																					
<b>TOTAL FEES ENCLOSED =</b>	\$ 890.00																					
	Amount to be refunded:	\$																				
	charged:	\$																				

a. ☒ A check in the amount of \$ 890.00 to cover the above fees is enclosed.

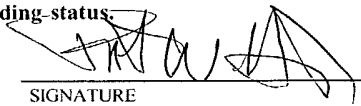
b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees.  
 A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any  
 overpayment to Deposit Account No. 50-0241. A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card  
 information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR  
 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:  
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 805 S.W. Broadway, #2740  
 Portland, Oregon 97205  
 Customer No. 21034

  
 SIGNATURE  
 Patrick W. Hughey  
 NAME  
 31,169  
 REGISTRATION NUMBER

**IN THE US PATENT AND TRADEMARK OFFICE**

In re Application of: RIDDOCH, H.                      Group Art Unit:

Application No: Unassigned                      Batch:

Filed: Herewith                      Examiner:

For: *External Rotor Brushless DC Motor*

**PRELIMINARY AMENDMENT**

ASSISTANT COMMISSIONER FOR PATENTS  
Washington, D.C. 20231

Dear Sir:

Please enter the following amendments prior to examination of this application.

**In the Claims**

Please cancel the present claims 1 - 37 in the international application and substitute therefor the following claims 38 - 55:

38. A fan having a frame manufactured from a plastics material and incorporating an external rotor brushless DC motor, the motor comprising:

a stator assembly base having a base plate;

the stator assembly base being manufactured from a thermally conductive material;

a winding assembly affixed to the stator assembly base; and

circuitry associated with the motor, wherein the base plate is disposed between the circuitry and the winding assembly and has a side wall depending away from the winding assembly, the side wall being within an air flow generated, in use, by the fan and comprising part of a heat transfer path to dissipate heat away from the motor.

39. A fan according to Claim 38, wherein the circuitry is attached to or supported by the base plate.

40. A fan according to Claim 38, wherein the circuitry has heat generating components which are attached to the base plate.
41. A fan according to Claim 38, wherein the side wall defines a recess within which the circuitry is located.
42. A fan according to Claim 38, wherein the base plate is provided with a cover, the circuitry being located between the base plate and the cover.
43. A fan according to Claim 38, wherein the circuitry is housed within an enclosure.
44. A fan according to Claim 43, wherein the enclosure is hermetically sealed.
45. A fan according to Claim 38, wherein the stator assembly base includes means for supporting the winding assembly.
46. A fan according to Claim 38, wherein the circuitry is in the form of a printed circuit board having a plurality of components mounted thereon.
47. A fan according to Claim 46, wherein at least some of the components on the printed circuit board are positioned on the opposite surface of the printed circuit board to that adjacent the base plate.
48. A fan according to Claim 46, wherein at least some of the components on the printed circuit board are positioned on the surface of the printed circuit board adjacent the base plate.
49. A fan according to Claim 46, wherein the components are positioned on both surfaces of the printed circuit board.
50. A fan according to Claim 40, wherein at least one of the high heat generating components is mounted on a printed circuit board and overhangs the edge of the printed circuit board and attaches directly to the base plate hence conducting heat away from the component into the base plate.
51. A fan according to Claim 40, wherein at least one of the high heat generating components is located proximal an aperture in a printed circuit board, a projection from the base plate contacting the at least one component through the aperture to conduct heat away from the component into the base plate.

52. A fan according to Claim 38, wherein the winding assembly comprises a number of multipole stator laminations with windings.

53. A fan according to Claim 38, wherein the motor has a cover plate and the cover plate comprises a part of the fan housing.

54. A fan according to any Claim 38, wherein the stator assembly base is manufactured from aluminum.

55. A fan having a frame manufactured from a plastics material and incorporating an external rotor brushless DC motor, the motor comprising:

a stator assembly base manufactured from aluminum and having a base plate;

a winding assembly affixed to the stator assembly base; and

circuitry associated with the motor, wherein the base plate is disposed between the circuitry and the winding assembly and has a side wall depending away from the winding assembly, the side wall being within an air flow generated, in use, by the fan and comprising part of a heat transfer path to dissipate heat away from the motor.

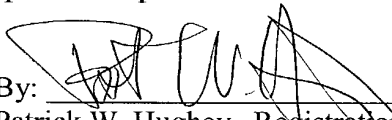
#### REMARKS

For the Examiner's reference, claims 38 – 53 are based upon claims 17 – 32 as attached to the enclosed International Preliminary Examination Report (IPER), and favorably considered in that report. Claim 54 is based upon claim 6 attached to the IPER, and claim 55 is an independent claim comprising a combination of claims 1 and 6 attached to the IPER.

If the Examiner has any questions concerning the foregoing, he/she is invited to contact applicant's attorney at the below listed telephone number.

Respectfully submitted,

ipsolon llp

By:   
Patrick W. Hughey, Registration No. 31,169

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Tel. (503) 419-0704

10/08983902

Attorney Docket No. 1085-043-PWH

Rec'd PCT/PTO 06 AUG 2002

**IN THE US PATENT AND TRADEMARK OFFICE**

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In re Application of: RIDDOCH, H.

Group Art Unit:

Application No: 10/089,839

Batch:

Filed: Oct 4, 2000

Examiner:

For: *External Rotor Brushless DC Motor*

**SECOND PRELIMINARY AMENDMENT**

ASSISTANT COMMISSIONER FOR PATENTS  
Washington, D.C. 20231

Dear Sir:

Please enter the following amendments prior to examination of this application and prior to calculation of claim fees.

**In the Claims**

Please cancel the present claims 1 - 32 in the international application and substitute therefor the following claims 33 - 50:

33. A fan having a frame manufactured from a plastics material and incorporating an external rotor brushless DC motor, the motor comprising:
- a stator assembly base having a base plate;
  - the stator assembly base being manufactured from a thermally conductive material;
  - a winding assembly affixed to the stator assembly base; and
  - circuitry associated with the motor, wherein the base plate is disposed between the circuitry and the winding assembly and has a side wall depending away from the winding assembly, the side wall being within an air flow generated, in use, by the fan and comprising part of a heat transfer path to dissipate heat away from the motor.
34. A fan according to Claim 33, wherein the circuitry is attached to or supported by the base plate.

35. A fan according to Claim 33, wherein the circuitry has heat generating components which are attached to the base plate.
36. A fan according to Claim 33, wherein the side wall defines a recess within which the circuitry is located.
37. A fan according to Claim 33, wherein the base plate is provided with a cover, the circuitry being located between the base plate and the cover.
38. A fan according to Claim 33, wherein the circuitry is housed within an enclosure.
39. A fan according to Claim 38, wherein the enclosure is hermetically sealed.
40. A fan according to Claim 33, wherein the stator assembly base includes means for supporting the winding assembly.
41. A fan according to Claim 33, wherein the circuitry is in the form of a printed circuit board having a plurality of components mounted thereon.
42. A fan according to Claim 41, wherein at least some of the components on the printed circuit board are positioned on the opposite surface of the printed circuit board to that adjacent the base plate.
43. A fan according to Claim 41, wherein at least some of the components on the printed circuit board are positioned on the surface of the printed circuit board adjacent the base plate.
44. A fan according to Claim 41, wherein the components are positioned on both surfaces of the printed circuit board.
45. A fan according to Claim 35, wherein at least one of the high heat generating components is mounted on a printed circuit board and overhangs the edge of the printed circuit board and attaches directly to the base plate hence conducting heat away from the component into the base plate.
46. A fan according to Claim 35, wherein at least one of the high heat generating components is located proximal an aperture in a printed circuit board, a projection from the base plate contacting the at least one component through the aperture to conduct heat away from the component into the base plate.

47. A fan according to Claim 33, wherein the winding assembly comprises a number of multipole stator laminations with windings.

48. A fan according to Claim 33, wherein the motor has a cover plate and the cover plate comprises a part of the fan housing.

49. A fan according to any Claim 33, wherein the stator assembly base is manufactured from aluminum.

50. A fan having a frame manufactured from a plastics material and incorporating an external rotor brushless DC motor, the motor comprising:

a stator assembly base manufactured from aluminum and having a base plate;

a winding assembly affixed to the stator assembly base; and

circuitry associated with the motor, wherein the base plate is disposed between the circuitry and the winding assembly and has a side wall depending away from the winding assembly, the side wall being within an air flow generated, in use, by the fan and comprising part of a heat transfer path to dissipate heat away from the motor.

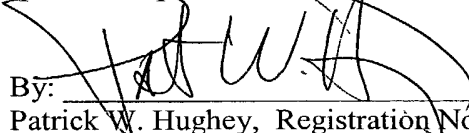
### REMARKS

For the Examiner's reference, claims 33 – 48 are based upon claims 17 – 32 as attached to the enclosed International Preliminary Examination Report (IPER), and favorably considered in that report. Claim 49 is based upon claim 6 attached to the IPER, and claim 50 is an independent claim comprising a combination of claims 1 and 6 attached to the IPER.

If the Examiner has any questions concerning the foregoing, she is invited to contact applicant's attorney at the below listed telephone number.

Respectfully submitted,

~~ipsolon llp~~

By: 

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Tel. (503) 419-0704



**"An external rotor brushless DC motor"**

THIS INVENTION relates to an external rotor brushless DC motor.

For many years external rotor brushless DC motors have been manufactured in accordance with a conventional topography. An example of such a conventional topography of a brushless DC motor is shown in Figure 1 of the accompanying drawings. The basic premise of this topography is that the stator assembly has a stator assembly base with a recess therein. The driving and control circuitry for the motor is attached to the stator assembly base in the recess, the stator windings being located above the circuitry such that the circuitry is sandwiched in the recess between the stator windings and the stator assembly base. Typically, the stator windings and the circuitry are permanently affixed to the stator assembly base.

Despite drawbacks associated with this topography, there have been little or no attempts to deviate from the conventional topography described above since this type of motor was first made over 20 years ago.

There are a number of drawbacks associated with the above described conventional motor topography. These drawbacks all stem from the conventional location of the printed circuit board at a position between the stator assembly base and the stator windings. For example, since the stator windings are almost always permanently affixed to the stator assembly base, it is extremely difficult to modify or repair the circuitry or components on the

printed circuit board without at least partially damaging or destroying the stator windings, or the assembly base. It is often the case that it is cheaper to scrap a motor rather than to attempt to repair or maintain the circuitry associated with the motor.

A further drawback is that it is difficult to dissipate heat, generated by both the motor and the circuitry on the printed circuit board, away from the motor.

Another drawback is that it is difficult to seal the printed circuit board and the components thereon from the ingress of dust and moisture.

A further drawback is that it is also difficult to dissipate the heat, generated by both the motor and the drive circuitry on the printed circuit board, which in many cases restricts the power output of the motor.

It is an object of the present invention to seek to provide an external rotor brushless DC motor which does not suffer from the above-mentioned drawbacks.

Accordingly, one aspect of the present invention provides an external rotor brushless DC motor comprising: a stator assembly base having a base plate; a winding assembly affixed to the stator assembly base; and circuitry associated with the motor, wherein the base plate is disposed between the circuitry and the winding assembly and is provided with a cover to define an enclosure, the circuitry being located between the base plate and the cover within the enclosure which is hermetically sealed.

Preferably, the circuitry is attached to or supported by the base plate.

Conveniently, the base plate comprises a substantially circular base plate having a substantially cylindrical side wall, the side wall defining a recess within which the circuitry is located.

Advantageously, the stator assembly base include means for supporting the stator windings.

Preferably, the stator assembly base is manufactured from aluminium or any other material with good thermal conduction.

Conveniently, the circuitry is in the form of a printed circuit board having a plurality of components mounted thereon, the components on the printed circuit board being positioned on either or both surfaces of the printed circuit board.

Preferably at least some, if not all of the high power dissipating components on the printed circuit board can overhang the printed circuit board and be attached to the assembly base P, hence conducting the heat directly into the assembly base, alternatively the heat dissipating components can be located over an aperture in the printed circuit board allowing them to be clamped to a projecting area on the assembly base so conducting the heat into the assembly base.

Another aspect of the present invention provides a fan incorporating a motor embodying the present invention.

Advantageously, the fan has a frame which is manufactured from a plastic material or other low cost easily manufactured material.

Conveniently, the motor has a cover plate and the cover plate comprises a part of the fan housing which is so constructed that the outer edge of the assembly base is in the airflow of the fan and hence cooled by the said airflow.

In order that the present invention may be more readily understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a cross-section through a conventional brushless DC motor;

FIGURE 2 is a cross-section through a first embodiment of an external rotor brushless DC motor according to the present invention;

FIGURE 3 is a plan view of the brushless DC motor of Figure 2;

FIGURE 4 is a cross-section through a second embodiment of an external rotor brushless DC motor according to the present invention;

FIGURE 5 is a cross-section through a third embodiment of an external rotor brushless DC motor according to the present invention; and

FIGURE 6 is a schematic cross-section through a fan having a plastics frame incorporating a brushless DC motor embodying the present invention.

Referring now to Figure 1, this shows a conventional topography of an external rotor brushless DC motor 1. The motor 1 comprises a stator assembly and a rotor assembly. The stator assembly has a stator assembly base which comprises a substantially circular base 2 having an outer upstanding cylindrical side wall 3. A central cylindrical column 4 is also upstanding from the centre of the circular base 2 and is concentric with the cylindrical side wall 3 so as to define an annular space between the cylindrical side wall 3 and the column 4. It is conventional for the driving and control circuitry of the motor to be housed within this annular space, typically on an annular printed circuit board 5 with the main surface of the printed circuit board 5 which carries all the components 6 being oriented toward the base 2. The printed circuit board 5 is typically permanently connected to and attached to a plurality of multipole stator laminations with windings around each pole forming a stator winding assembly 7 which is attached to the stator assembly base and, more particularly, to the exterior of the column 4 directly above the base 2, the printed circuit board 5 thereby being sandwiched between the stator winding assembly 7 and the base 2. The stator winding assembly 7 is permanently attached to the column 2 preferably by a thermoset resin or other permanent adhesive. It should be appreciated that the annular space within which the printed circuit board 5 is to be affixed opens towards the stator winding assembly 7.

The rotor assembly comprises a rotor cup 8 having a series of permanent magnet poles of opposite polarity 9 arranged around the internal periphery thereof. The cup 8 is rotatably engaged in the column 4 by means of a shaft 10 held between two pairs of bearings 11 within the column 4.

The drawbacks associated with the above described conventional motor topography all stem from the conventional location of the printed circuit board at a position between the housing base 2 and the stator assembly 7 which are typically both permanently affixed together. It is, therefore, extremely difficult to modify or repair the circuitry or components on the printed circuit board without at least partially damaging or destroying the stator winding assembly or the bases.

Other drawbacks include the difficulty of sealing the printed circuit board and the components thereon from the ingress of dust and moisture and the difficulty of dissipating heat, generated by both the motor and the circuitry on the printed circuit board, away from the motor and isolating the electronic components from the heat generated within the stator winding assembly 7.

In order to address these problems, the present invention provides a departure from the conventional topography used in external rotor brushless DC motors. An example of a motor embodying the present invention is shown in Figure 2.

Referring now to Figures 2 and 3 and using the same reference numerals used in connection with the conventional motor assembly shown in Figure 1, it will be apparent that the rotor assembly is no different and the stator winding assembly 7 is affixed to the column 4 in a conventional manner. However, the difference between the motor embodying the present invention and the conventional motor assembly shown in Figure 1 lies in the base portion of the stator assembly.

The stator assembly base 20 of the motor 1 embodying the present invention comprises an effective inversion of the arrangement shown in Figure

## 7

1. The stator assembly base 20 comprises a conventional column 4 upstanding from a circular base plate 21. A cylindrical side wall 22 projects from the base plate 21 in the opposite direction to the column 4, the side wall 22 thereby projecting away from the stator winding assembly 7, in the opposite direction to the column 4. Thus, there is no recess between the stator winding assembly 7 and the base plate 21 within which the printed circuit board 5 can be mounted.

In contrast to the conventional topography, the side wall 22 which depends away from the stator winding assembly 7 defines a space on the opposite side of the base plate 21 to the stator winding assembly 7 within which the circuitry associated with the motor can be mounted. Thus, the recess defined by the side wall 22 and the base plate 21 opens away from the stator winding assembly 7.

A cover plate 23 is seated on an internal step formed around the free edge of the side wall 22. An enclosure 24 is thereby defined between the base plate 21 and the cover plate 23 which is bounded by the side wall 22. Preferably, further bosses 25 or partition walls (not shown) are formed within the side wall 22 so as to provide, respectively, means by which the cover plate 23 can be secured to the base plate 21 and means to divide the main enclosure 24 into various sub-enclosures within the boundary of the side wall 22.

In the embodiment of the motor shown in Figure 2, a printed circuit board 5 is attached to the base plate 21. The components 6 on the printed circuit board 5 are positioned on the opposite surface of the printed circuit board 5 to that adjacent the base plate 21. Therefore, the components 6 are readily accessible upon removal of the cover plate 23. Thus, the components 6 and circuitry of the printed circuit board 5 can be easily repaired or maintained

without any need to cause damage to the winding assembly 7 or any other part of the stator assembly. Suitable wiring 7A connects the winding assembly 7 to the printed circuit board 5 through the base plate 21. The opening through which the wiring 7A passes through the base plate 21 is sealed by a rubber seal or the like.

The provision of the enclosure 24, within which to mount the printed circuit board for the motor, on the opposite side of the base plate 21 to the stator windings 7 provides other advantages. The enclosure 24 is hermetically sealable by a rubber O-ring 33 or other similar sealing arrangement so as to protect the circuitry and components within the enclosure 24 from the ingress of dust or moisture. Additionally, the thermal transfer properties of the motor are enhanced in that heat from the motor can be more readily dissipated through the stator assembly, along the base plate 21, down the side wall 22 and from the cover plate 23. External heat sinks or the like may be connected to the cover plate 23 to facilitate further heat sinking.

Preferably, the stator assembly base is manufactured from aluminium or any other thermally conductive material.

A further embodiment of the invention would use the same motor construction using a plastic or non-conductive base, allowing the hermetic sealing of the electronic components.

Figure 4 shows another embodiment of the motor in which one or more components 6A of the circuitry overhang the printed circuit board 5 so as to be attached directly to the base plate 21 hence conducting the heat directly into the base plate 21. This arrangement is especially advantageous for high power dissipating components.



Figure 5 shows a further embodiment of the motor in which the printed circuit board 5 is provided with an aperture 26 through which an extension 27 from the base plate 21 projects. A high power dissipating component 6A is located over the aperture 26 on the opposite surface of the printed circuit board 5 to the base plate 21. The extension 27 from the base plate 21 contacts the component 6A so as to provide a heat conduction path directly from the component 6A to the base plate 21.

One particular application for motors embodying the present invention is in the field of fans and ventilation equipment, particularly axial flow fans. Fans having high power brushless DC motors typically have a frame manufactured from aluminium because it is not possible to utilise cheaper plastics materials due to the heat generated from the motor.

However, when using a motor embodying the present invention, it is possible to produce a fan 30 of hybrid construction having an aluminium stator assembly base 20 but with a plastics frame 31 as shown in Figure 6. This is because the airflow created by the fan 30 will convect heat away from the motor 1. Airflow generated by the fan 30 passes over the side wall 22 of the stator assembly base 20 which comprises part of the heat transfer path away from the motor 1. Thus, the frame 31 of the fan 30 is subjected to less heat than would be experienced by a fan incorporating a conventional brushless DC motor. Preferably, the cover plate 23 for the stator assembly base 20 comprises a part of the fan housing 32 thereby providing an easy means by which the fan housing can be mechanically connected to the motor 1.

In the present specification "comprise" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

**CLAIMS:**

1. An external rotor brushless DC motor comprising:  
a stator assembly base having a base plate;  
a winding assembly affixed to the stator assembly base; and  
circuitry associated with the motor, wherein the base plate is disposed between the circuitry and the winding assembly and is provided with a cover to define an enclosure, the circuitry being located between the base plate and the cover within the enclosure which is hermetically sealed.
2. A motor according to Claim 1, wherein the circuitry is attached to or supported by the base plate.
3. A motor according to Claim 1, wherein the heat generating components of the circuitry are attached to the base plate.
4. A motor according to any preceding claim, wherein the base plate comprises a base plate having a side wall, the side wall defining a recess within which the circuitry is located.
5. A motor according to any preceding claim, wherein the stator assembly base include means for supporting the winding assembly.
6. A motor according to any preceding claim, wherein the stator assembly base is manufactured from aluminium or other thermally conductive material.
7. A motor according to any preceding claim, wherein the circuitry is in the form of a printed circuit board having a plurality of components mounted thereon.

8. A motor according to Claim 10, wherein some or all of the components on the printed circuit board are positioned on the opposite surface of the printed circuit board to that adjacent the base plate.
9. A motor according to Claim 10, wherein some or all of the components are positioned on the surface of the printed circuit board adjacent the base plate.
10. A motor according to Claim 10, wherein the components are positioned on both surfaces of the printed circuit board.
11. A motor according to any preceding claim, wherein high heat generating components overhang the edge of the printed circuit board and attach directly to the base plate hence conducting heat away from the component into the base plate.
12. A motor according to any preceding claim, wherein high heat generating components are located proximal an aperture in the printed circuit board, a projection from the base plate contacting at least one component through the aperture to conduct heat away from the component into the base plate.
13. A motor according to any preceding claim, wherein the winding assembly comprises a number of multipole stator laminations with windings.
14. A fan incorporating a motor according to any preceding claim.
15. A fan according to Claim 17 having a frame, wherein the frame is manufactured from a plastics material.
16. A fan according to Claim 17 or 18, wherein the motor has a cover plate and the cover plate comprises a part of the fan housing.

17. A fan having a frame manufactured from a plastics material and, incorporating an external rotor brushless DC motor, the motor comprising:
- a stator assembly base having a base plate;
  - the stator assembly base being manufactured from a thermally conductive material;
  - a winding assembly affixed to the stator assembly base; and
  - circuitry associated with the motor, wherein the base plate is disposed between the circuitry and the winding assembly, and has a side wall depending away from the winding assembly, the side wall being within the air flow generated, in use, by the fan and comprising part of a heat transfer path to dissipate heat away from the motor.
18. A fan according to Claim 17, wherein the circuitry is attached to or supported by the base plate.
19. A fan according to Claim 17, wherein the heat generating components of the circuitry are attached to the base plate.
20. A fan according to any one of Claims 17 to 19, wherein the side wall defines a recess within which the circuitry is located.
21. A fan according to any one of Claims 17 to 20, wherein the base plate is provided with a cover, the circuitry being located between the base plate and the cover.
22. A fan according to any one of Claims 17 to 21, wherein the circuitry is housed within an enclosure.

23. A fan according to Claim 22, wherein the enclosure is hermetically sealed.
24. A fan according to any one of Claims 17 to 23, wherein the stator assembly base include means for supporting the winding assembly.
25. A fan according to any one of Claims 17 to 24, wherein the circuitry is in the form of a printed circuit board having a plurality of components mounted thereon.
26. A fan according to Claim 25, wherein some or all of the components on the printed circuit board are positioned on the opposite surface of the printed circuit board to that adjacent the base plate.
27. A fan according to Claim 25, wherein some or all of the components are positioned on the surface of the printed circuit board adjacent the base plate.
28. A fan according to Claim 25, wherein the components are positioned on both surfaces of the printed circuit board.
29. A fan according to any one of Claims 17 to 28, wherein high heat generating components overhang the edge of the printed circuit board and attach directly to the base plate hence conducting heat away from the component into the base plate.
30. A fan according to any one of Claims 17 to 29, wherein high heat generating components are located proximal an aperture in the printed circuit board, a projection from the base plate contacting at least one component through the aperture to conduct heat away from the component into the base plate.

31. A fan according to any one of Claims 17 to 30, wherein the winding assembly comprises a number of multipole stator laminations with windings.

32. A fan according to any one of Claims 17 to 31, wherein the motor has a cover plate and the cover plate comprises a part of the fan housing.

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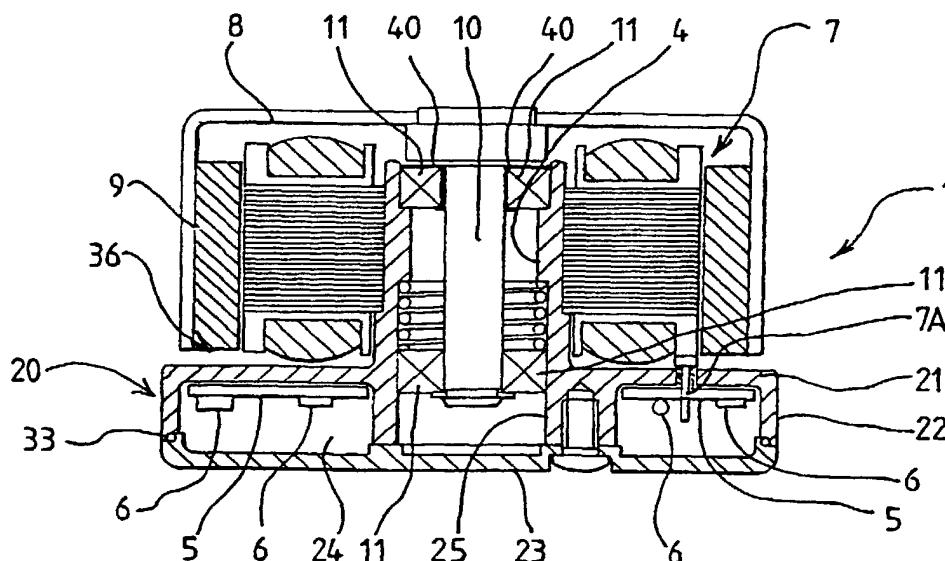
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(54) Title: AN EXTERNAL ROTOR BRUSHLESS DC MOTOR



(57) Abstract: An external rotor brushless DC motor for use in a fan, or other similar application, the motor comprising: a stator assembly base having a base plate(21); a number of stator windings (7) affixed to the stator assembly base; and circuitry (5, 6) associated with the motor, wherein the base plate (21) is disposed between the circuitry and the stator windings.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

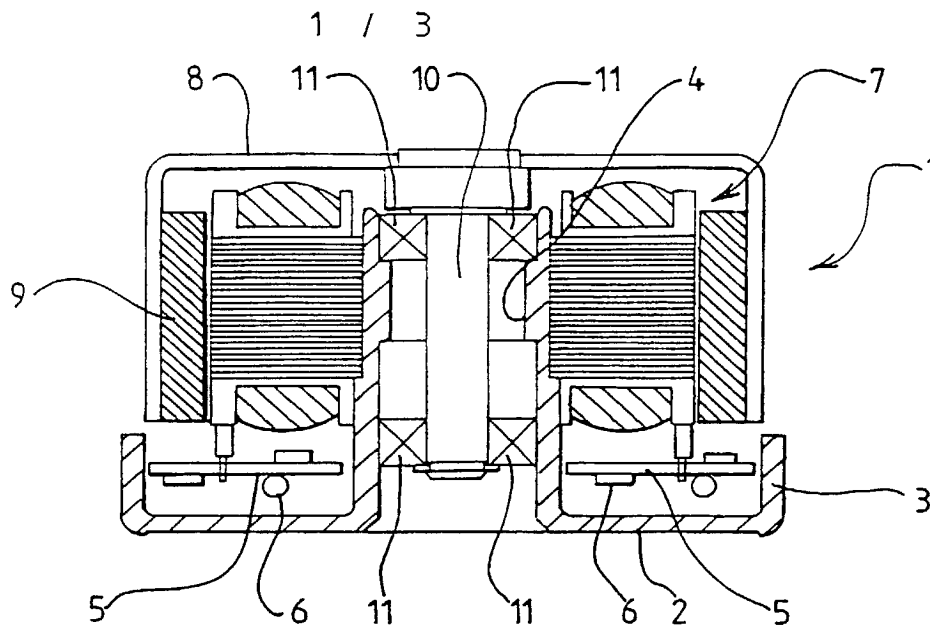


FIG 1

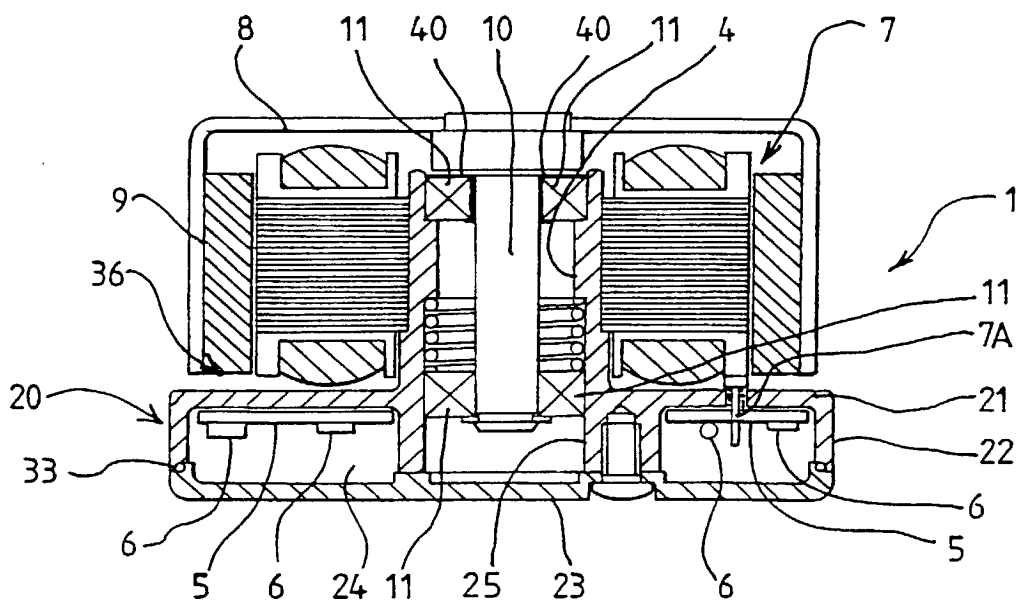


FIG 2

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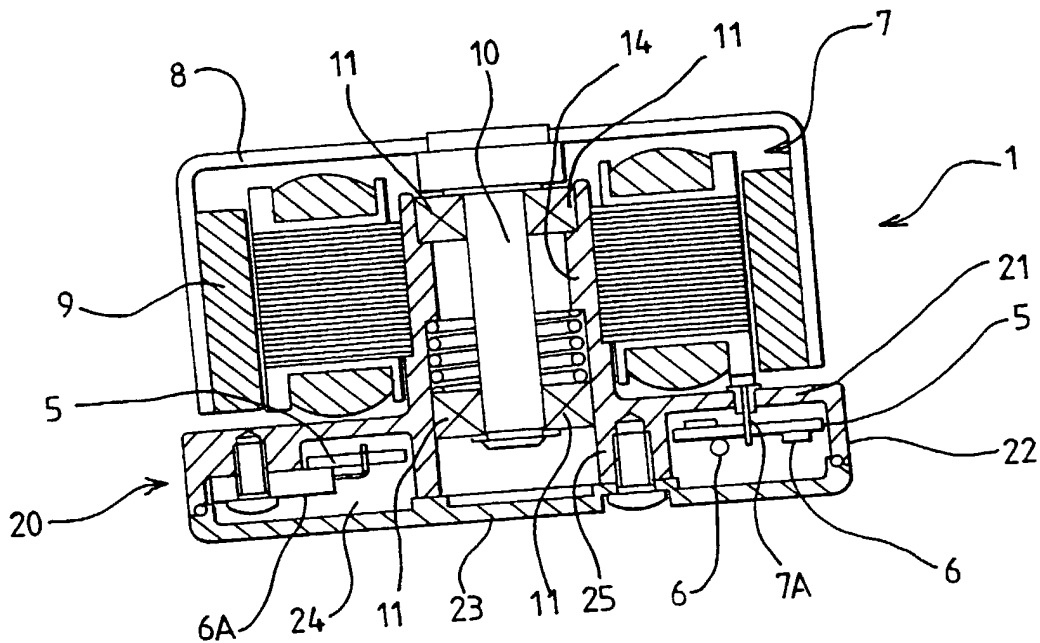
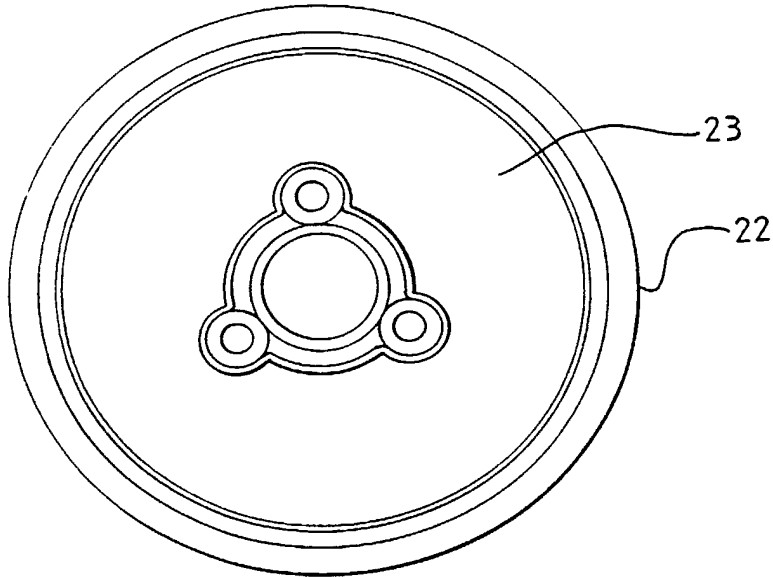


FIG 4

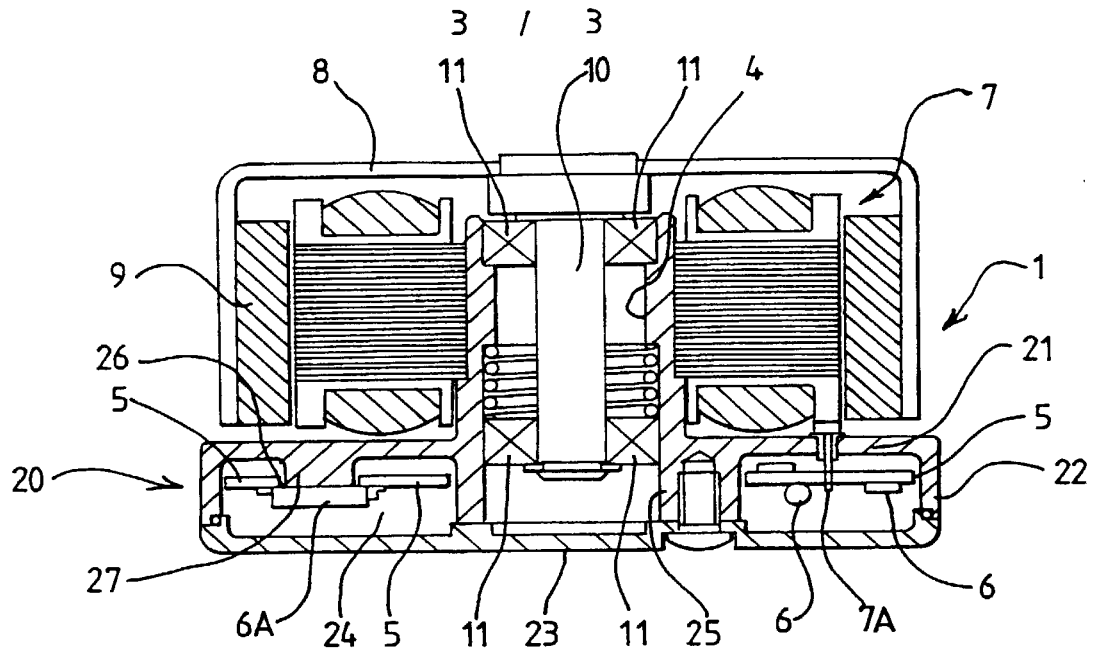


FIG 5

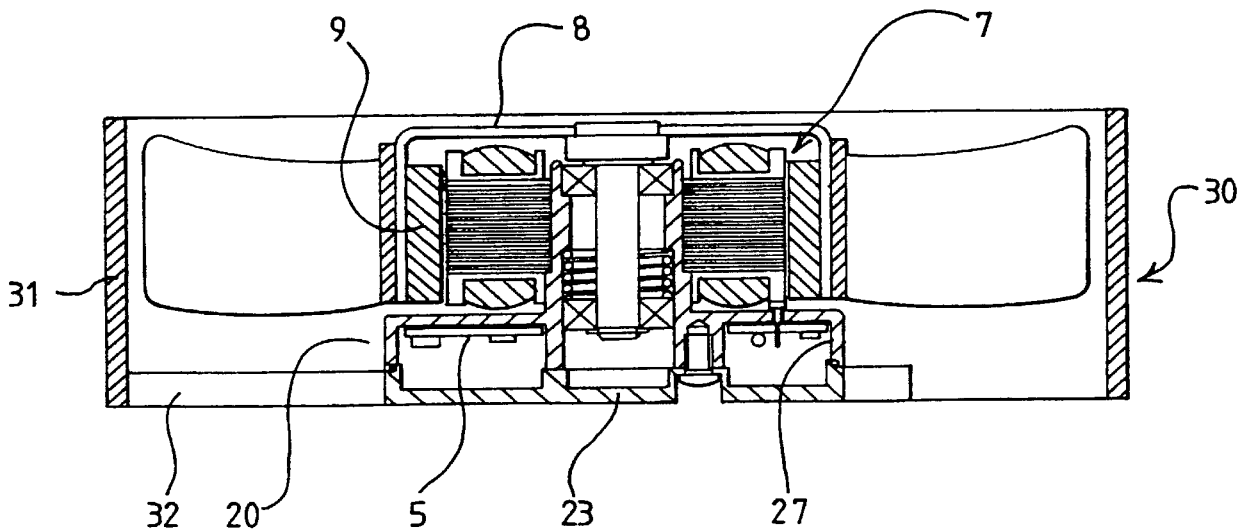


FIG 6

<b>DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION</b>  <input type="checkbox"/> Declaration Submitted with Initial Filing <input checked="" type="checkbox"/> Declaration Submitted after Initial Filing	Attorney Docket Number	1085-043-PWH
	First Named Inventor	Riddoch, H.
	COMPLETE IF KNOWN	
	Application Number	10/089,839
	Filing Date	10 April 2000
	Group Art Unit	
	Examiner's Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**External Rotor Brushless DC Motor**

the specification of which

☐ is attached hereto; OR

☒ was filed on 4 October 2000 as International Application Number PCT/GB00/03816 and has been assigned a US National Phase Application No. 10/089,839.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code § 119 (a) - (d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application Numbers	Country	Foreign Filing Date	Priority Not Claimed	Certified Copy Attached?	
				Yes	No
9923900.6	GB	8 Oct 1999	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet attached hereto.

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below:

Application Number(s)	Filing Date	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet attached hereto.

I hereby claim the benefit under Title 35, United States Code § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority sheet attached hereto.

**DECLARATION – Utility or Design Patent Application**

As a named inventor, I hereby appoint the following registered practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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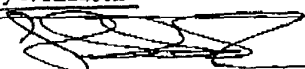
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

First or Sole Inventor

☐ A petition has been filed for this unsigned inventor.

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